Recent books

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B. Beckman: *Codebreakers: Arne Beurling and the Swedish Crypto Program during World War II,* *American Mathematical Society, Providence, 2002, 259 pp., $39, ISBN 0-8218-2889-4*
All stories about cryptanalytical work prior and during the World War II read like a thriller. The book under review is no exception. The author, the former head of the cryptanalytical section of FRA (The Radio Agency of the Swedish Defence Forces), presents a well of information. Its highlight is the detailed description of Arne Beurling's solution of the German Siemens machine, one of the most magnificent achievements of cryptanalysis of that time. During the previous century, in the thirties and the first half of the forties, the cryptanalytical work of cryptographic "superpowers" (Poland, England, and USA) became dominated by mathematicians. The transition of secret services to the search of cryptanalytical talents among graduates of mathematics departments probably started in Poland and people like Marian Rejewski became the founders of modern mathematically based cryptology. Well known are the contributions of Alan Turing to the war efforts in Bletchley Park. Arne Beurling is another, though less known, example of a top class mathematician serving his country as a cryptanalytician during the war times.

The book starts with an explanation of what a code and a cipher is. Then the author overviews the Swedish cryptanalytical history to the end of the World War II. Most of the book is based on declassified Swedish documents and it traces the work of Arne Beurling in solving various ciphers used by different countries during the war, including the top secret German ciphers. For the reviewer it is particularly interesting to read about the Beurling solution of the cipher used by a Czech resident in Sweden named Vaněk to communicate with the Czechoslovak Government exiled in London. The second part of the book is dedicated to the life and mathematical work of Arne Beurling, a close friend and collaborator of Lars Ahlfors. The book can be highly recommended to anyone interested in the role of mathematics in classical cryptology and in the history of the 20th century. (jtu)

J. Borwein, D. Bailey: *Mathematics by Experiment. Plausible Reasoning in the 21st Century,* *A. K. Peters, Natick, 2003, 350 p., $45, ISBN 1-56881-211-6*
J. Borwein, D. Bailey, R. Girgensohn: *Experimentation in Mathematics. Computational Path to Discovery,* *A. K. Peters, Natick, 2004, 350 p., $49, ISBN 1-56881-136-5*
Despite the slightly different titles, the books form two volumes of the same publication. Mathematical experiments performed on computers are more and more important factors of further development in the mathematics. The text is carefully written and the plentiful short remarks on related topics are pleasant to read. The material is mostly accessible without knowledge of advanced parts of modern mathematics. A certain familiarity with computer algebra programs like *Maple* or *Mathematica* is helpful for a reader willing to try these things in practice. The first volume of the work contains a gentle introduction to experimental mathematics in its historical context and to its methodology, using a series of well-chosen examples. The first chapter shows it as a rapidly developing field of mathematics, the second contains further numerous illustrative examples. These quite often provoke a reader to work or play with the examples on his own PC. The third chapter describes the progress in computing π, where both authors made significant contributions (BBP formula for computing π). A chapter on normality of numbers deals with another fascinating problem in which experimental mathematics promises at least some path to future discoveries. In contrast to the fact that the book introduces to the reader a highly up-to-date part of mathematics, the next chapter offers another look at classical themes like the fundamental theorem of algebra, the Gamma function or Stirling's formula. After an exposition on basic tools, the book is closed by a chapter with the title 'Making sense of experimental mathematics'.

For those wanting to know more on the progression from numerical experiments to hypotheses and finally to deep mathematical theorems proven within the frame of "classical mathematics", the authors prepared the second volume of the work together with R. Girgensohn. In fact, both volumes can be read independently.

The second volume starts with a chapter on sequences, series, products and integrals, which is followed by the chapter on Fourier series and integrals. These chapters form one third of the book and will be of interest to any open-minded person with a deeper interest in mathematics, equipped with a basic knowledge of undergraduate mathematics. The following chapters on zeta functions and multi-zeta functions, partition, powers, primes and polynomials are more specialised. The final two chapters invite a reader to explore deeper methods and tools of experimental mathematics. Each chapter in both volumes is closed by commentaries and additional examples. The amount of collected material is tremendous. It is impossible to describe the content of the whole work in detail in just a few lines. These are very nice and provoking books showing that experiments both were and are an important part of the development of mathematics. New computer-based tools are broadly used mainly "outside" mathematics and the book shows "... how today, the use of advanced computing technology provides mathematicians with an amazing, previously unimaginable 'laboratory', in which examples can be analysed, new ideas tested, and patterns discovered." I strongly recommend visiting e.g. web-site on URL *http://www.expmath.info*, where some parts of the first volume are also available. Also the very good typesetting and nice graphical appearance of the whole work are worth mentioning. It can be recommended not only to libraries but to all members of the mathematical community. (jive)

T. Brzezinski, R. Wisbauer: *Corings and Comodules,* *London Mathematical Society Lecture Note Series 309, Cambridge University Press, Cambridge, 2003, 476 pp., £37,95, ISBN 0 521-53931-5*
This is a first comprehensive monograph on corings and comodules. Corings are generalizations of coalgebras: while a coalgebra is an R-module over a commutative associative unital ring R, equipped with an R-linear coproduct and a comultiplication, a coring is an (A,A)-bimodule over an associative, but not necessarily commutative, unital R-algebra A, equipped with a (A,A)-bilinear coproduct and comultiplication. Corings can also be viewed as coalgebras in a particular monoidal category (the 'tensor category'). As observed by Takeuchi, important examples of corings are the so-called entwining structures connecting R-algebras with R-coalgebras. Moreover, in the particular case of bialgebra entwinings, entwined modules are exactly the classical Hopf modules. So - and this is the point of the book - the theory of corings and comodules is a natural common generalization of several theories connecting algebra with category theory, noncommutative geometry, and quantum physics.

The book consists of six chapters and an Appendix. After developing coalgebra and comodule theory from the module-theoretic point of view in Chapter 1, the authors deal with bialgebras, classical Hopf algebras and their modules in Chapter 2. The module theoretic approach of Chapter 1 pays back in Chapter 3, where basics of the coring and comodule theory are developed. Chapter 4 deals with an important class of corings coming from ring extensions (together with the BOCS's of Rojter and Kleiner, these were the first examples of corings truly generalizing coalgebras). Chapters 5 and 6 deal with the relation to entwinings and weak entwinings. The Appendix recalls basics on the module category $\sigma[M]$, which is one of the main tools for the theory. The reason is that any right comodule over a coring C is a left module over the left dual ring ${}^*C$, and, for example, the so called 'left α-condition' just says that the category of all right C-comodules coincides with $\sigma[{}^*{}_C C]$. The book provides a unified and general treatment of a theory whose pieces were originally developed by people working in rather distinct areas of algebra, category theory, noncommutative geometry, and mathematical physics. The book is a welcome addition to the literature on this young and rapidly developing subject. (jtrl)

V. M. Buchstaber, T. E. Panov: *Torus Actions and Their Applications in Topology and Combinatorics,* *University Lecture Series, vol. 24, American Mathematical Society, Providence, 2002, 144 pp., $29, ISBN 0-8218-3186-0*
This book is an outgrowth of an extensive paper "Torus actions, Combinatorial topology and homological algebra", written by the authors and published in Uspekhi Mat. Nauk (Russian Math. Surveys) in 2000. It is yet another contribution to the recent rich interplay of combinatorics and convex geometry with algebraic geometry and topology. In Chapters 1-5, the authors review basic notions of both the combinatorial and topological side with a slight preference for combinatorial notions (which they consider less familiar to a prospective reader). The last three chapters are devoted to their own contribution, which is centred around moment angle complexes, their cohomology and to subspace arrangements. This is a useful book that will be of interest to the (algebraic) combinatorics community as well as to researchers in algebraic geometry and topology. It is a carefully written state of the art book. (jneš)

B. Buffoni, J. Toland: *Analytic Theory of Global Bifurcation,* *Princeton Series in Applied Mathematics, Princeton University Press, Princeton, Oxford, 2003, 169 pp., £29,95, ISBN 0 691-11298-3*

In the book, bifurcation problems for non-linear operator equations in infinite dimensional spaces are studied. To read the book requires certain knowledge, hence the first three chapters are devoted to a review (without proofs) of basic notions and facts from linear functional analysis, nonlinear functional analysis (e.g., the implicit function theory) and from the theory of analytic operators in Banach spaces. Main facts on holomorphic functions of several complex variables, real analytic functions of several real variables and on (finite-dimensional) analytic varieties, can be found in the next three chapters respectively. Analytic sets (in the complex setting, or their real version) have a nice, distinguished structure, which can be used in a study of analytic operator equations in infinite dimension. A tool needed for such a relation is a suitable version of the implicit function theorem, reducing infinite dimensional questions to finite dimension. The last two chapters contain applications of previous methods to steady periodic water waves. (vs)

H. Cabral, F. Diacu, Eds.: *Classical and Celestial Mechanics: The Recife Lectures,* *Princeton University Press, Princeton, 2002, 385 pp., £35, ISBN 0-691-05022-8*

This book has its origin in a lecture series hosted by the Federal University of Pernambuco in Recife, Brazil, between 1993 and 1999. Immediately after opening the book, one gets a feeling of the great enthusiasm of its editors, organizers of the corresponding series of lectures. It is a really attractive book, presenting many important topics from Hamiltonian dynamics and celestial mechanics in an accessible way. The editors and the mathematical centre in the equator, colonial city of Recife, deserve great admiration for producing such an impressive output - a record of their long term seminar, devoted to classical mechanics. (Several contributions to the seminar were published independently, before the publication of this book.)

The book contains the following contributions: Central configurations and relative equilibria for the N-body problem (by D. Schmidt), Singularities of the N-body problem (by F. Diacu), Lectures on the two-body problem (by A. Albouy), Normal forms of Hamilton systems and stability of equilibria (by H. E. Cabral), The Poincaré compactification and applications to celestial mechanics (by E. Pérez-Chavela), The motion of the moon (by D. Schmidt), Lectures on geometrical methods in mechanics (by M. Levi), Momentum maps and geometric phases: Overview, classical adiabatic angles, holonomy for gyrostats, microswimming (by J. Koiller et al.), and Bifurcation from families of periodic solutions (J. K. Hale and P. Táboas). (mzah)

A. Candel, L. Conlon: *Foliations II,* *Graduate Studies in Mathematics, vol. 60, American Mathematical Society, Providence, 2003, 545 pp., $79, ISBN 0-8218-0809-5*

This is the second volume of the two-volume series with the title Foliations. It has three independent parts, describing three special topics in the theory of foliations: Analysis on foliated spaces, Characteristic classes of foliations and Foliated 3-manifolds. Each part contains a description of a topic in foliation theory and its relation to another field of contemporary mathematics. In the first part, the C^*- algebras of foliated spaces are studied and some of the classical notions from Riemannian geometry (heat flow and Brownian motion) are generalized to foliated spaces. Necessary analytic background can be found in three appendices. The second part is devoted to characteristic classes and foliations. Here the reader can find constructions of exotic classes based on the Chern-Weil theorem, vanishing theorem for Godbillon-Vey classes and a discussion on obstructions to existence of a foliation transverse to the fibres of circle bundles over surfaces. In the third part, compact 3-manifolds foliated by surfaces are studied. Special methods of 3-manifolds topology yield existence theorems and further results unique for dimension three. There is an appendix with a proof and further discussion of Palmeiras theorem, which says that the only simply connected n-manifold foliated by leaves diffeomorphic to R^{n-1} is R^n. The book contains a lot of interesting results and can be recommended to anybody interested in the topic. (jbu)

X. Chen, K. Guo: *Analytic Hilbert Modules,* *CRC Research Notes in Mathematics 433, Chapman & Hall/CRC, Boca Raton, 2003, 201 pp., $99,95, ISBN 1-58488-399-5*

The main theme of the book is the structure of modules over function algebras of holomorphic functions in several complex variables. The book concentrates mainly on topics developed by both authors. The book starts with a nice introduction summarizing main results described in the book. Chapter 2 describes the technique of characteristic space theory for analytic Hilbert modules, which was developed by K. Guo. Chapter 3 shows that analytic Hilbert modules in several variables have a much more rigid structure than in one variable. The equivalence problem for Hardy submodules in the cases of the polydisk or the unit ball is treated in Chapter 4. The next chapter describes the structure of the Fock space, or more generally, reproducing function spaces on C^n. Chapter 6 contains a discussion of modules over the Arveson space of square integrable functions on the unit ball in C^n. In the last chapter, the authors describe the extension theory of Hilbert modules over function algebras. The book is written in a clear and systematic way and it describes an interesting part of the recent development in the field. Each chapter ends with useful bibliographic comments. (vs)

I. Dolgachev: *Lectures on Invariant Theory,* *London Mathematical Society Lecture Note Series 296, Cambridge University Press, Cambridge, 2003, 220 pp., £29,95, ISBN 0-521-52548-9*

In many problems in mathematics, the structure of the set of all orbits of a group acting on a suitable space is described by means of invariants of the group action. In particular, the case of the action of a linear algebraic group G on an algebraic variety X is the case studied in classical invariant theory. The present book is intended for beginners as a first introduction to the theory. Knowledge of fundamental notions and basic facts from algebraic geometry is expected. The purpose of the book is to offer a short description of main ideas of the classical invariant theory illustrated by many specific examples. Every chapter ends with a set of exercises and with hints for further reading.

The first two chapters treat the classical example of the action of the group $GL(V)$ on homogeneous polynomials of degree m on the space E, where E itself is the space of homogeneous polynomials of degree d on V. In the next chapter, the Nagata theorem on the algebra of invariant polynomials on the space of a linear rational representation of a reductive algebraic group is proved. The next chapter is devoted to linear rational representations of a non-reductive algebraic group, including the Nagata counterexample to Hilbert's 14th problem. Covariants of the action are treated in Chapter 5. Categorical and geometric quotients and linearization of the action, a notion of stability of an algebraic action together with numerical criterion of stability are described next. The last three chapters treat some special cases (hypersurfaces in projective space, ordered sets of linear subspaces in projective space, and toric varieties). (vs)

R. M. Dudley: *Real Analysis and Probability, Cambridge* *Studies in Advanced Mathematics 74, Cambridge University Press, Cambridge, 2002, 555 pp., £32,95, ISBN 0-521-80972-X*

This book serves as a clear, rigorous, and complete introduction to modern probability theory using methods of mathematical analysis, and a description of relations between the two fields. The first half of the book is devoted to an exposition of real analysis. Starting with basic facts of set theory, the book treats e.g. the real number system, transfinite induction, and problems of cardinality, touching both the continuum hypothesis and axiom of choice together with its equivalences. General topology is discussed, including compactness and compactification, completion and completeness, and metric. Measure theory and integration is treated carefully, because it serves as the most important tool for probability theory. Among more advanced topics of real and functional analysis, we can find here an introduction to functional analysis on Banach and Hilbert spaces, convex functions, convex sets and dualities, and measures on topological spaces. The second half of the book contains a description of modern probability theory, including convergence laws, central limit theorems and laws of large numbers. Ergodic theory, as well as martingales, is studied. More advanced topics include convergence laws on separable metric spaces, stochastic processes and Brownian motion. The book can be considered as a textbook. It is a self-contained text and all relevant facts are proved. The appendices show that the author carefully filled all gaps in mathematical background needed later. The book contains a number of exercises helping to understand the contents. It could be very useful for students interested in learning both topics, it can also serve as complementary reading to standard lectures. Teachers preparing their graduate level courses can use the book as an excellent, rigorously written and complete source. (mrok)

J. Faraut, F. Rouviére, M. Vergne: *Analyse sur les groupes de Lie et théorie des représentations,* *Séminaires & Congrés 7, Société Mathématique de France, Paris, 2003, 177 pp., €40, ISBN 2-85629-142-2*

The book is based on lectures presented at the summer school on analysis on Lie groups and representation theory, held in 1999 in Kénitra, Morocco. It contains a written form of three series of lectures. The first one (given by M. Vergne, recorded by S. Paycha) contains a description of the equivariant cohomology of a manifold, which was introduced independently by N. Berline and M. Vergne, E. Witten and M. F. Atiyah and R. Bott in the 80's. In the special case of S^1-action with isolated fixed points, the Paradan formula is used for a description of the equivariant cohomology in terms of fixed points of the action. As an important application, it is shown how to obtain the Duistermaat-Heckman stationary phase formula for a U(1)-action on a symplectic manifold.

The second series of lectures (given by F. Rouviére) was devoted to the Damek-Ricci spaces. A manifold is harmonic if the mean value theorem holds for harmonic functions. The Damek-Ricci spaces are harmonic manifolds but they are not symmetric spaces. Basic facts from geometry and harmonic analysis on the Damek-Ricci spaces are described in the course.

The third series of lectures (given by J. Faraut) is devoted to Hilbert spaces of holomorphic functions invariant under the action of a group of automorphisms of a complex manifold. The set of such Hilbert spaces forms a convex cone and it is possible to use methods of the Choquet theory for a description of its structure and for an integral representation of their reproducing kernels. The last parts are devoted to the case of invariant domains in the complexification of a compact symmetric space. A part of the school's program was reserved for lectures on the research work of participants, the list of lectures and their abstracts can be found in the book. The book brings nice reviews of very interesting areas of the field. (vs)

M. Feistauer, J. Felcman, I. Straškraba: *Mathematical and Computational Methods for Compressible Flow,* *Numerical Mathematics and Scientific Computation, Clarendon Press, Oxford, 2003, 535 pp., £59,95, ISBN 0-19-850588-4*

The book deals with the numerical solution of equations describing motion of compressible fluids. Classical as well as modern numerical schemes are summarized here. At the beginning, the governing equations are determined and the mathematical problems are defined. Some theoretical results, such as existence and uniqueness of solutions, are mentioned. The main part of the book is concerned with the numerical solution of inviscid as well as viscous compressible flows. Applications of various numerical methods (finite volume method, finite element method, discontinuous Galerkin method and their variants) for the Euler and Navier-Stokes equations are discussed. Convergence properties of numerical schemes are mostly derived for a scalar nonlinear convection-diffusion equation. Several types of mesh adaptation techniques are presented as well. In the book the reader can find a lot of numerical examples demonstrating the efficiency of described methods. The book is suitable for researchers as well as for students dealing with the numerical solution of compressible flows. (jdol)

W. Fenchel, J. Nielsen: *Discontinuous Groups of Isometries in the Hyperbolic Plane,* *de Gruyter Studies in Mathematics 29, Walter de Gruyter, Berlin, 2003, 364 pp., €78,50, ISBN 3-1-017526-6*

In 1920's and 1930's, J. Nielsen published three long papers in Acta Mathematica on discontinuous groups of isometries of the non-euclidean plane. His further research in the field led him to the idea to describe the theory of discontinuous groups of isometries systematically and in full generality. After the Second World War, he started a project along these lines together with W. Fenchel and they prepared the first version of the manuscript. W. Fenchel was able to continue (with his collaborators) the work on the project after J. Nielsen's death and the typewritten version of the manuscript was ready at the end of the 80's.

The book under review is the final version of the manuscript, which was prepared for publication by A. L. Schmidt after W. Fenchel's death in 1988. It offers a systematic geometric treatment of discontinuous groups of isometries. It starts with a careful description of Möbius transformations of the Riemann sphere and their use in non-euclidean geometry. The second chapter contains a detailed description of discontinuous groups of motions of the unit discs with its hyperbolic metric. In the third chapter, associated surfaces and invariants needed for a classification are discussed. Elementary groups and elementary surfaces, the decompositions of the discontinuous groups and their normal forms, are all treated in the fourth chapter. The final chapter is devoted to isomorphisms of discontinuous groups, homeomorphisms of the corresponding discs and their extensions to the boundary. A specific feature of the book is that it is based entirely on geometric arguments. The Fenchel-Nielsen manuscript has been famous for a long time already and its final publication is a valuable edition to mathematical literature. (vs)

M. Georgiadou: *Constantin Carathéodory, Mathematics and Politics in Turbulent times,* *Springer, Heidelberg, 2004, 651 pp., €89,95, ISBN 3-540-44258-8*

This is an excellent biography of a man who belongs to the most renowned mathematicians of the first half of the 20th century. More than 50 years after his death – much later than his contribution to the science deserves – this book brings his personality and work to life again. It depicts them in full context with that period, so rich on far reaching revolutionary events, in a very lively and suggestive way. Being a German mathematician born in an outstanding Greek family of diplomats, Constantin Carathéodory was attached to German intellectual tradition by his German education, as well as to Greece by his emotions. Moreover, a man of his intellectual influence must have also been a man of political significance. Because of these facts and in connection with the dramatic period in which he lived, he is very suitable subject for a biography. The author has gathered with exceptional care almost all accessible material that has a bearing to the life of this scientist, and has built a narrative that will fascinate everyone who opens the book. (jdr)

M. Gidea, C. P. Niculescu: *Chaotic Dynamical Systems: An Introduction,* *Centre for Nonlinear Analysis and its Applications 3, Universitaria Press, Craiova, 2003, 239 pp., €10, ISBN 973-8043159-9*

The book aims to be an introduction to the theory of dynamical systems on the graduate level. It covers all classical topics of the subject, including structural stability, Lyapunov exponents, the horse-shoe dynamics, hyperbolic and symbolic dynamics, chaotic attractors, entropy, ergodicity and invariant measures. The particular emphasis is given to the concept of chaos and the various mathematical tools for its understanding. The exposition is clear and concise, yet perfectly rigorous. Many simple examples and a number of exercises serve excellently to the purpose of the book to be an elementary introduction. The only minor setback seems to be a somewhat lesser quality of the print. (dpr)

M. Gross, D. Huybrechts, D. Joyce: *Calabi-Yau Manifolds and Related Geometries,* *Universitext, Springer, Berlin, 2003, 239 pp., €49,95, ISBN 3-540-44059-3*

Summer schools in Nordfjordeid, Norway, have been organized regularly since 1996. Topics vary each year but there are always three series of lectures by invited experts with evening exercises. The school held in June 2001 was devoted to recent interaction between differential and algebraic geometry. The book consists of notes written by lecturers of the corresponding three series of lectures. The first contribution (by D. Joyce) is devoted to the introduction and study of Riemannian properties. The last contribution (by D. Huybrechts) describes compact hyperkähler manifolds. The class of compact hyperkähler manifolds form an interesting class of Ricci-flat manifolds, playing an important role in different branches of mathematics and mathematical physics. In this part, many interesting topics are presented (including theory of holomorphic symplectic manifolds, deformation theory of complex structures, cohomology and other properties of compact hyperkähler manifolds, twistor space and moduli space of a hyperkähler manifold and a discussion of the projectivity of hyperkähler metrics). The themes of all three contributions are interrelated and together they give a nice introduction into a very interesting field of research on the border between mathematics and physics. I would like to strongly recommend the book to anybody interested in the topic. (jbu)

B. C. Hall: *Lie groups, Lie algebras, and representations: An Elementary Introduction,* *Springer, Heidelberg, 2003, 351 pp., €59,95, ISBN 0-387-40122-9*

To present a circle of ideas around Lie groups, Lie algebras and their representations, it is necessary to make a few principal choices. The first question is how to describe a relation between Lie groups and Lie algebras. To make the book accessible to a broader audience, the author does not suppose knowledge of the theory of manifolds. He restricts the attention to matrix groups. Lie algebra of G is then defined using simple properties of the exponential map. As for the correspondence between Lie group homomorphisms and Lie algebra homomorphisms, the author is using the Baker-Campbell-Hausdorff theorem for its description.

In the main part of the book, finite dimensional representations of classical semisimple Lie groups are classified by their highest weights. Their construction is given in three different ways (as quotients of Verma modules, or by the Peter-Weyl theorem, or by the Borel-Weil realization). The proof of the complete reducibility is based on properties of representations of compact groups. The Weyl character formula and the classification of complex semisimple Lie algebras end the main part of the book. To keep prerequisites minimal, the author also offers a few appendices. The book is written in a systematic and clear way, each chapter ends with a set of exercises. The book could be valuable for students of mathematics and physics as well as for teachers, for the preparation of courses. It is a nice addition to the existing literature. (vs)

U. Hertrich-Jeromin: *Introduction to Möbius Differential Geometry,* *London Mathematical Society Lecture Note Series 300, Cambridge University Press, Cambridge, 2003, 413 pp., £29,95, ISBN 0-521-53569-7*

The book is an introduction to the geometry of submanifolds of the conformal n-sphere. A Möbius transformation is a conformal (i.e., angle preserving) transformation of the sphere. The sphere can be considered as a homogeneous space of the group of Möbius transforms, hence it is a model of Möbius geometry from F. Klein's point of view. There are several other models of Möbius geometry (projective model, quaternionic model and Clifford algebra model). Classically, a conformal structure is represented by a Riemannian metric (modulo a multiplication by a positive function). The change of Riemannian properties under conformal change is described and the Weyl and Schouten tensors are introduced. Conformal flatness is discussed in details. The projective model and related objects (congruencies, etc.) are introduced in the first chapter. The Cartan method of moving frames is often used for computations. As an application of projective model constructions, conformally flat hypersurfaces, isothermic and Willmore surfaces are discussed. A quaternionic model introduced in the next chapter is used for a study of isothermic surfaces in the four-dimensional case, while in higher dimensions, the Clifford algebra model is used. At the end of the book, the reader can find a discussion of triply orthogonal systems, their Ribaucour transformations and isothermic surfaces of arbitrary codimension. The book is a well-written survey of classical results from a new point of view and a nice textbook for a study of the subject. (jbu)

J. Ize, A. Vignoli: *Equivariant Degree Theory,* *de Gruyter Series in Nonlinear Analysis and Applications 8, Walter de Gruyter, Berlin, 2003, 361 pp., €98, ISBN 3-11-017550-9*
The aim of the book is the development and applications of the degree theory in the context of equivariant maps. (Equivariant simply means that the mapping has certain symmetries, e.g., being even/odd, periodic, rotational invariant, etc.). The theory is developed both in finite and infinite dimension. The first chapter gives necessary preliminaries. The second chapter brings the definition of the degree and studies its basic properties. As the definition is somewhat abstract (the degree is defined as an element of the group of equivariant homotopy classes of maps between two spheres), it is useful to compute the degree in various particular cases. This is accomplished in Chapter 3. The last and also the longest chapter, deals with applications to particular ODE's and to bifurcation theory. The aim of the authors was to write a book that would be easily accessible even to non-specialists, thus the exposition is accompanied by a number of examples and the use of abstract special tools is limited. It is also worth noting that each chapter is accompanied by detailed bibliographical remarks. (dpr)

C. U. Jensen, A. Ledet, N. Yui: *Generic Polynomials: Constructive Aspects of the Inverse Galois Problem,* *Mathematical Sciences Research Institute Publications 45, Cambridge University Press, Cambridge, 2003, 258 pp., £45, ISBN 0-521-81998-9*
The inverse Galois problem is to determine, for a given field K and a given finite group G, whether there exists a Galois extension of K, whose Galois group is isomorphic to G. And if there is such an extension, to find an explicit polynomial over K, whose Galois group is the prescribed group G. The authors present a family of "generic" polynomials for certain finite groups, which give all Galois extensions having the required group as their Galois group. The existence of such generic polynomials is discussed and a detailed treatment of their construction is given in those cases, when they exist. (jtu)

D. S. Jones, B. D. Sleeman: *Differential Equations and Mathematical Biology*, *Chapman & Hall/CRC Mathematical Biology and Medicine Series, Chapman & Hall/CRC, Boca Raton, 2003, 390 pp., $71,96, ISBN 1-58488-296-4*
The book is written with two aims: firstly, to be an introduction both to ordinary and partial differential equations; secondly, to present main ideas on how to model deterministic (and mostly continuous) processes in biology, physiology and ecology. The style of writing is subordinated to these purposes. It is remarkable that without the classical scheme (definition, theorem and proof) it is possible to explain rather deep results like properties of the Fitz-Hugh-Nagumo model of nerve impulse transmission or the Turing model of pattern formation. This feature makes the reading of this text pleasant business for mathematicians also. There exists a similar book written by J. D. Murray (Mathematical Biology), which contains more biological models. In comparison with it, the book under review is also a textbook on differential equations. It can be recommended for students of mathematics who like to see applications, because it introduces them to problems on how to model processes in biology, and also for theoretically oriented students of biology, because it presents constructions of mathematical models and the steps needed for their investigations in a clear way and without references to other books. (jmil)

J. W. Kammeyer, D. J. Rudolph: *Restricted Orbit Equivalence for Actions of Discrete Amenable Groups,* *Cambridge Tracts in Mathematics 146, Cambridge University Press, Cambridge, 2002, 201 pp., £35, ISBN 0-521-80795-6*
The main topic of the book belongs to ergodic theory and measurable dynamics. It studies suitable notions of similarity of two dynamical systems using structure of orbits of corresponding systems. The authors discuss free and ergodic actions of countable discrete amenable groups. The key notions in the book are an orbit relation $O=\{x,T_g(x)\}_{g\in G}\subset X \times X$ generated by the action, an orbit equivalence (a measure preserving map carrying one orbit relation to the other), and arrangements and rearrangements of orbits. Basic definitions and examples can be found in Chapter 2 (the vocabulary of arrangements and rearrangements, and m-equivalence classes of an arrangement). Fundamental results by Ornstein and Weiss on ergodic theory of actions of amenable groups are reviewed in Chapter 3. The next two chapters include key technical lemmas and entropy theory for restricted orbit equivalences. Chapter 6 contains a construction of a topological model for arrangements and rearrangements using a notion of Polish spaces and Polish actions. The last chapter contains a formulation and a proof of the equivalence theorem. Similar questions were studied carefully in the last decades for Z-actions as well as for Z_d -actions (d≥ 1). Relations of the results described in the book to results obtained in these special cases can be found in the Appendix. (vs)

V. V. Kravchenko: *Applied Quaternionic Analysis,* *Research and Expositions in Mathematics, vol. 28, Heldermann, Lemgo, 2003, 127 pp., €24, ISBN 3-88538-228-8*
Function theory for the Dirac equation has grown substantially during the last several decades. The case of dimension four is special in two ways – it is a physical dimension and spinor fields can be identified with quaternionic functions of a quaternionic variable. Obtained results were applied to a wide spectrum of problems in mathematical physics. The first part contains a summary of basic facts from quaternionic analysis, including integral formulae for unbounded domains. The selection of topics is guided by their possible applications. Boundary problems for Maxwell equations in homogeneous media and the Dirac equation for a free particle are treated in the second part. The last part contains a discussion of Maxwell equations for inhomogeneous media, the Dirac equation with potentials, and a generalization of the Riccati equation to a nonlinear quaternionic equation. The book can be useful not only for mathematicians interested in the field but also for engineers (the book is based on a course given by the author to future engineers). (vs)

T. Lawson: *Topology: A Geometric Approach,* *Oxford Graduate Texts in Mathematics 9, Oxford University Press, Oxford, 2003, 388 pp., £45, ISBN 0-19-851597-9*
The book is a nice introduction to topology with an emphasis on its geometric aspects. It is written for two purposes. In the first part, consisting of three chapters, there is material suitable for a one semester basic course of topology. It starts with basic point set topology with special attention to the topology of R^n, followed by a description of the classification of surfaces. The last topic introduced and studied in this part is the fundamental group of a space, including its application to surfaces and the vector field problem in the plane and on surfaces. To compute fundamental groups, the Seifert-van Kampen theorem is introduced and proved.

The second part contains an extension of the material of the first part to a full-year course. It starts with the description of covering spaces, covering transformations and universal covering space, followed by a study of CW-complexes and their properties from a homotopy point of view. Simplicial complexes and Δ-complexes for CW-complexes are described as well. The last chapter is devoted to the homology theory with special attention to its relations to homotopy. There are about 750 exercises of different levels, which can attract students to a more active study of the subject. Solutions of selected exercises are included as an appendix (solutions to all exercises are available to the instructor in electronic form on application to Oxford University Press). The book is an excellent introduction to the subject and be can recommended to anybody interested in geometry and topology as his/her first reading. (jbu)

J. Lewin: *An Interactive Introduction to Mathematical Analysis,* *Cambridge University Press, Cambridge, 2003, 492 pp., £27,95, ISBN 0-521-01718-1*
The book under review provides an introduction to mathematical analysis using possibilities of computers. The book starts with some background material concerning quantifiers, sets, logic formulas, and methods of proofs. The second part deals with the set of real numbers, limits of sequences and functions, differentiation of functions, the Riemann integral, and infinite series. The next chapters are devoted to improper integrals, sequences and series of functions and integration of functions of two variables. The enclosed CD forms an important on-screen part of the book. The CD contains a lot of exercises with solutions. Some parts of the book are explained here in a more detailed way and some chapters are added (e.g., calculus of several variables or complex variable calculus) or are treated in an alternative (advanced) way. This book together with the CD will be useful to many students. (mzel)

E. L. Lima: *Fundamental Groups and Covering Spaces,* *A. K. Peters, Natick, 2003, 210 pp., $49, ISBN 1-56881-131-4*
The book is an introduction to a part of algebraic topology. It concentrates on the circle of ideas around homotopy theory, fundamental groups and

covering spaces. The first part of the book introduces a general concept of a homotopy, together with a particular case of path homotopy. The fundamental group is defined and computed for many examples, including real and complex projective spaces and classical matrix groups. The fundamental group of the circle is related to winding numbers of plane curves. The second part of the book is devoted to basic properties of (differentiable) covering spaces and their relations to fundamental groups. Each chapter ends with exercises. The book starts from the beginning and its reading requires only a basic knowledge. The book is a pleasure to read, it contains a lot of illustrations and presentation is clear and systematic. (vs)

M. Métivier: *Semimartingales. A Course on Stochastic Processes,* *de Gruyter Studies in Mathematics 2, Walter de Gruyter, Berlin, 1982, 287 pp., €68, ISBN 3-11-008674-3*

The presented monograph is an advanced book on general martingale theory. A reader with a good knowledge of probability and discrete time processes will appreciate the deep results contained in the book. Theorems are formulated for quasimartingales, some parts of the book are devoted to Hilbert space valued processes, and the theory is not restricted to continuous square integrable martingales as is usually the case. Due to these facts, the book is a necessity for all researchers working with general stochastic processes.

The book consists of two parts. In the first part the general theory of martingales is given. It starts with basic definitions and facts from stochastic processes; filtration, measurability, adapted and predictable processes, stopping time, and decomposition. The next chapters continue with the martingale property. We find many classical results in a quite general context like Doob's inequalities or convergence theorems. The first part is concluded by a chapter devoted to square integrable semimartingales, quadratic variation and Meyer's process. Here we also find the theory of Hilbert space valued martingales and stochastic integrals with respect to them. In the second part, stochastic calculus is the focus. First, the stochastic integral is built and a semimartingale version of Itô transformation theorem is proved. Then, as an application, the Brownian and Poisson processes are considered and changes of probability, as well as Girsanov formula, are presented. The book culminates with a chapter on SDE. This is not a book which I would recommend as an introduction to stochastic processes and martingales. But for any rigorous work in the theory of martingales, namely non-continuous processes, semimartingales and multidimensional martingales, it is the book that should be consulted first. It is not easy to write a concise book on general martingale theory but in my opinion Michel Métivier has done great job. (dh)

I. Moerdijk, J. Mrčun: *Introduction to Foliations and Lie Groupoids,* *Cambridge Studies in Advanced Mathematics 91, Cambridge University Press, Cambridge, 2003, 173 pp., £30, ISBN 0-521-83197-0*

This is just a small book nicely covering principal notions of the theory of foliations and its relations to recently introduced notions of Lie groupoids and Lie algebroids. After the first chapter, containing a definition of a foliation and main examples and constructions, the authors introduce the key notion of holonomy of a leaf, a definition of an orbifold and they prove the Reeb and the Thurston stability theorems. Chapter 3 contains the Haefliger theorem (there are no analytic foliations of codimension 1 on S^3) and the Novikov theorem (concerning existence of compact leaves in a codimension 1 transversely oriented foliation of a compact three-dimensional manifold). The Molino structure theorem for foliations defined by nonsingular Maurer-Cartan forms is treated in Chapter 4. A holonomy groupoid of a foliation is a basic example of so called Lie groupoids. The last two chapters describe properties of Lie groupoids, a notion of weak equivalence between Lie groupoids, a special class of étale groupoids, and a Lie algebroid as an infinitesimal version of a Lie groupoid. The book is based on course lecture notes and it still keeps its qualities and nice presentation. (vs)

T. Mora: *Solving Polynomial Equation Systems I: The Kronecker-Duval Philosophy,* *Encyclopedia of Mathematics and its Applications 88, Cambridge University Press, Cambridge, 2003, 423 pp., £60, ISBN 0-521-81154-6*

This is an excellent book for readers interested in algebraic methods. A part of the content will not be new to most of them; its usefulness lies in the fact that so much is brought together in one book. In the first part of the book, the author describes the Kronecker-Duval approach to the solution of systems of polynomial equations. The second part contains a discussion of factorisation of polynomials. The author says: "It is my firm belief that the best way of understanding a theory and an algorithm is to verify it through computation …" Accordingly, the book contains 52 numerical examples provided with solutions and 27 programs. I enjoyed the author's language enormously. The author's words from the preface "the number of hidden mistakes in a draft is always larger than the number of the found ones" are true. I spotted a few, e.g., in Theorem 5.2.3 as well as in Theorem 5.5.6, one has to add the assumption that the degree of considered polynomials is at least one. This criticism of the text is a little more than a quibble and, in any case, is greatly outweighed by its virtues.
(lber)

J. Nestruev: *Smooth Manifolds and Observables,* *Graduate Texts in Mathematics, vol. 220, Springer, New York, 2003, 222 pp., €64,95, ISBN 0-387-95543-7*

Main themes of the book are manifolds, fibre bundles and differential operators acting on sections of vector bundles. A classical treatment of these topics starts with a coordinate description of a manifold M; the algebra of smooth functions on M is a derived object in this approach. The present book is based on an alternative point of view, where calculus on manifolds is treated as a part of commutative algebra. In particular, the initial object is a commutative associative unital algebra F with certain additional properties. The corresponding smooth manifold is reconstructed as the spectrum of F. (A generalization to the non-commutative case, which is usually called non-commutative geometry, is based on this point of view. This generalization, however, is not treated in the book.)

The first few chapters describe properties of algebras that correspond to smooth manifolds, introduce a notion of charts and atlases and define smooth maps between such manifolds. The authors (J. Nestruev is an invented name hiding a group of authors) then show equivalence of the algebraic definition with the usual one. In the second part of the book, the authors define tangent and cotangent fibre bundles of a manifold, jet bundles and they introduce linear differential operators in this algebraic setting. As explained throughout the book, and in particular in the appendix (written by A. M. Vinogradov), it is possible to give a motivation coming from classical mechanics for basic notions treated in the book. The commutative algebra F is related to the laboratory itself, elements of F to measuring devices and points in the spectrum of F to states of an observed physical system. The book contains quite a few exercises and many useful illustrations. (vs)

W. K. Nicholson, M. F. Yousif: *Quasi-Frobenius Rings,* *Cambridge Tracts in Mathematics 158, Cambridge University Press, Cambridge, 2003, 307 pp., £55, ISBN 0-521-81593-2*

Quasi-Frobenius algebras provide the basic setting for modular representation theory of finite groups. Indeed, the group algebra of any finite group is quasi-Frobenius. The presented book is a very accessible introduction to basic properties of quasi-Frobenius rings and the modules over them. Rather than dealing with classical representation theory, the authors consider a more general setting of mininjective rings and show that basics of the classical theory can be developed using only elementary module theory in a more general setting. (A ring is right mininjective, if any isomorphism between minimal right ideals is induced by a left multiplication. By a theorem of Ikeda, quasi-Frobenius rings are exactly the right and left mininjective, right and left artinian rings).

While basic notions and results on (weak) self-injectivity, *CS*- and *C2*-conditions, AB5*, and dualities are developed through Chapters 2-7, the reader is gradually introduced into three challenging open problems: the Faith Conjecture (whether every left or right perfect right self-injective ring is quasi-Frobenius), the FGF-Conjecture (whether the condition that every finitely generated module embeds in a free module implies that the ring is quasi-Frobenius), and the Faith-Menal Conjecture (asking whether any right strongly Johns ring is quasi-Frobenius. A ring R is right Johns, if R is right noetherian and each right ideal of R is an annihilator; R is right strongly Johns, if all full matrix rings $M_n(R)$, $n \geq 1$ are Johns). The latter conjecture is investigated in Chapter 8, where an example is given that the conjecture fails if the term 'strongly' is omitted. Chapter 9 deals with the Faith Conjecture, providing a generic construction of examples using particular $3x3$-upper triangular matrix rings with coefficients in bimodules over division rings.

The book concludes with three Appendices: on Morita theory of equivalence, on Bass' theory of perfect rings, and on the Camps-Dicks Theorem (proving that the endomorphism ring of any artinian module is semilocal). The authors have achieved two seemingly incompatible goals: to provide an elementary introduction to the classical theory of quasi-Frobenius rings, and to bring the reader up to the current research in the field. This makes the book interesting both for graduate students and researchers in contemporary module theory. (jtrl)

L. I. Nicolaescu: *The Reidemeister Torsion of 3-Manifolds,* *de Gruyter Studies in Mathematics, vol. 30, Walter de Gruyter, Berlin, 2003, 249 pp., €84, ISBN 3-11-017383-2*

This is a book on the Reidemeister torsion and its (mostly Turaev's) generalizations. When comparing it with Turaev's book (Introduction to

Combinatorial Torsions, Lectures in Mathematics, ETH Zürich, Birkhäuser, 2001), which appeared recently, we can immediately see that it has a different character. While Turaev's book can also serve as a kind of introduction to the subject (as well as an introduction to the contemporary research in the field), the book under review is devoted to a wide range of applications of the torsion, and its reading requires certain prerequisites.

In the first chapter, which makes the reader familiar with the necessary algebraic notions, the reader is supposed to have some topological (and also algebraic) background. The author modestly states in the introduction that this is a computationally oriented little book. But let us note that the "computations" we find here are very clever computations, and the wide variety of applications presented here do not support the description of a little book. The book will be indispensable for specialists in the field, and I think that it is very good that it exists together with Turaev's book. It is very well written, with many examples and also many exercises. The wide range of applications will be interesting not only for topologists but also for differential geometers. (jiva)

S. P. Novikov, V. A. Rohlin (Eds.): ***Topology II, Homotopy and Homology, Classical Manifolds,*** *Encyclopedia of Mathematical Sciences, Springer, Berlin, 2004, 257 pp., ISBN 3-540-51996-3*

The volume under review consists of three chapters: Introduction to Homotopy Theory (by O. Ya. Viro and D. B. Fuchs), Homology and Cohomology (again by O. Ya. Viro and D. B. Fuchs), and Classical Manifolds (by D. B. Fuchs). The original Russian text was translated by C. J. Shaddock. The presentation of notions and results in all three chapters is really very nice. The first two chapters contain quite detailed exposition, while the third chapter has a more encyclopedia like character. This means that the first two chapters can also serve very well as a textbook. I would even recommend them for this purpose, because the presentation is on one hand a detailed one (as already mentioned), and on the other hand it is not too long. The choice of material is very good, the text is saturated with many examples, and we find here information about further developments and recommendations for further study. Naturally, because this is an encyclopedia, we find no exercises. The last chapter contains information about the topology of classical manifolds, and I do not think that information of this type, in such a compact form and to such an extent, can be found elsewhere. Generally, the whole volume makes a very good impression, and I would say that it is very clearly written. (jiva)

H. Pajot: ***Analytic Capacity, Rectifiability, Menger Curvature and the Cauchy Integral,*** *Lecture Notes in Mathematics 1799, Springer, Berlin, 2002, 118 pp., €22,95, ISBN 3-540-00001-1*

The question of characterization of removable sets for bounded analytic functions is known as the Painlevé problem and has attracted the interest of mathematicians for more than 115 years. In a reformulation due to L. Ahlfors, the point is to describe for which sets the analytic capacity vanishes. In 1977, A. P. Calderón proved the Denjoy Conjecture that one-dimensional rectifiable curves are removable if and only if their Hausdorff length is zero. The proof was based on estimates of singular integrals, namely of the Cauchy operator. The version of the Vitushkin conjecture that a purely unrectifiable set of finite Hausdorff length is removable has been proved in 1998 by G.David, after significant steps forward by M. Melnikov, V. Verdera, P. Mattila, M. Christ and others. In this research the Menger curvature appeared to be relevant. In 2003, X. Tolsa characterized removable sets in terms of the Menger curvature. In this volume, the author presents the above mentioned results and related developments.

The first two chapters are devoted to the Hausdorff measure and rectifiability, including beta numbers and uniform rectifiability. The Menger curvature is explained in Chapter 3. In Chapter 4, the theory of singular integrals is applied to the Cauchy operator. The Painlevé problem and the analytic capacity are discussed in Chapter 5. In Chapter 6, the proofs of the Denjoy conjecture and of the Vitushkin conjecture as well as related results are presented. Some very recent results including the Tolsa theorem are given in Chapter 7. The book excellently explains this beautiful theory, which is a subtle mix of complex analysis, harmonic analysis and geometric measure theory. The text is almost self-contained. The history of this development is nicely reviewed. At the end, main open problems of the theory are listed. (jama)

J. Roe: ***Lectures on Coarse Geometry,*** *University Lecture Series, vol. 31, American Mathematical Society, Providence, 2003, 175 pp., $39, ISBN 0-8218-3332-4*

The book is based on lectures given by the author at Penn State University. The notion of 'coarse geometry' was invented to keep track of large scale properties of metric spaces. The first part of the book introduces an abstract notion of a coarse structure, a notion of a bounded geometry coarse space, its growth and a notion of an amenable metric space, and discusses coarse algebraic topology. The main topic in the middle part is the Mostow rigidity theorem saying that if two compact hyperbolic manifolds of dimensions at least 3 are homotopy equivalent, they are isometric. The last part of the book contains a discussion of a notion of asymptotic dimensions and uniform embeddings into Hilbert spaces, together with relations to the Kazhdan property of discrete groups. The book offers a very readable description of a circle of ideas around the notion of coarse geometry. (vs)

C. Sabot: ***Spectral Properties of Self-Similar Lattices and Iteration of Rational Maps,*** *Mémoires de la SMF 92, Société Mathématique de France, Paris, 2003, 104 pp., €25, ISBN 2-85629-133-3*

The method of a renormalization group, widely used in physics, produces some considerable mathematical difficulties, when applied to systems on usual, regular lattices. Hierarchical, self-similar lattices are much better suited for a detailed mathematical development of this method. The present book gives a detailed treatment of the problems, which were first studied by Rammal and Toulouse on the Sierpiński gasket, and puts them in a more general perspective. The goal of the book is to study systematically, in a mathematically rigorous way, the spectral properties of Laplace operators on self-similar sets. A new renormalization map, which is a rational map defined on a smooth projective variety, is introduced. Then, the characteristics of the spectrum of these operators are related with the characteristics of the dynamics of iterates of such a renormalization map. An explicit formula for the density of states is given, and it is shown that the spectral properties of the operator depend substantially on the asymptotic degree of the renormalization map. The contents (a slightly shortened list of the chapters of the book) are: Definitions and basic results (self-similar Laplacian, density of states); Preliminaries (Grassmann algebra, trace of a Dirichlet form); The renormalization map (construction, the main theorem in the lattice case); Analysis of the psh function G (the dichotomy theorem, asymptotic degree, regularity of the density of states, some related rational maps); Examples; Remarks, questions and conjecture; and Appendix (plurisubharmonic functions and positive currents, dynamics of rational maps on projective space, iteration of meromorphic maps on compact manifolds, G - Lagrangian Grassmanian). (mz)

I. Stewart: ***Galois Theory, third edition,*** *Chapman & Hall/CRC Mathematics, Chapman & Hall/CRC, Boca Raton, 2003, 288 pp., $44,96, ISBN 1-58488-393-6*

This is the third edition of the classic textbook of Galois theory, first published in 1972. But it is not just a reprint of earlier editions. Those who know the first two editions will be surprised by a radical change of presentation. The author reversed the original Bourbakiste approach expressed by a slogan "from general to concrete" and now presents the theory in the direction "from concrete to general".

Thus after a historical chapter, he starts with solutions in radicals of polynomial equations of degree 2, 3, 4, and presents a quintic equation solvable in radicals. Factorization of complex polynomials is developed from theory of polynomials with complex coefficients and the fundamental theorem of algebra. Field extensions of rational numbers follow including the definition of rational expressions and the degree of an extension. As a digression, the author proves non-existence of ruler-and-compass solutions of classical geometric problems of squaring the cube, trisecting the angle and squaring the circle. Then the Galois theory starts. After a short explanation of Galois groups according to Galois, he presents modern definitions of the Galois correspondence, splitting fields, normal and separable extensions, and field automorphisms. The fundamental Galois correspondence between the subfields of a field extension and subgroups of the automorphism group of the extension is proved. An example of the correspondence resulting from a quartic equation is also given. Solvable and simple groups are introduced and the Galois theorem about solvability of equations in radicals is proved.

After all this, abstract rings and fields are introduced and the abstract theory of field extensions is developed. The last part of the book contains some applications, e.g., the construction of finite fields, constructions of regular polygons, circle divisions (including cyclotomic polynomials) and an algorithm on how to calculate the Galois group of a polynomial equation. The penultimate chapter is about algebraically closed fields and the last chapter, on transcendental numbers, contains "what-every-mathematician-should-see-at-least-once", the proof of transcendence of π. The book is designed for the second and third year undergraduate courses. I will certainly use it. (jtu)

D. Stirzaker: ***Elementary probability,*** *Second edition, Cambridge University Press, Cambridge, 2003, 536 pp., £65, ISBN 0-521-83344-2*

This book provides an introduction to elementary probability and some of its applications. The word elementary means that the book does not need the abstract Lebesgue measure and integration theory, only elementary calculus is used. The strong feature of the textbook is a choice of good examples. Each theoretical explanation is accompanied by a large number of examples and followed by worked examples incorporating a cluster of exercises. The examples and exercises illustrate the treated topics and help the student solve the kind of problems typical of examinations. Each chapter concludes with problems. Solutions to many of these appear in an appendix, together with solutions to most of exercises.

The second edition of the book contains some new sections. A new section provides a first introduction to elementary properties of martingales, which is now occupying a central position in modern probability. Another section provides an elementary introduction to Brownian motion, diffusion, and the Wiener process, which has underpinned much of classical financial mathematics, such as the Black-Scholes formula for pricing options. Optional stopping and its applications are introduced in the context of these important stochastic models, together with several associated new examples and exercises. The list of chapters: Introduction, Probability, Conditional Probability and Independence, Counting, Random Variables: Distribution and Expectation, Random Vectors: Independence and Dependence, Generating Functions and Their Applications, Continuous Random Variables, Jointly Continuous Random Variables, and Markov Chains. Some sections can be omitted at a first reading (e.g. Generating Functions, Markov Chains). The book is suitable for a first university course in probability and very useful for self-study. (br)

E. B. Vinberg: ***A Course in Algebra,*** *Graduate Studies in Mathematics, vol. 56, American Mathematical Society, Providence, 2003, 511 pp., $89, ISBN 0-8218-3318-9*

The book covers all topics, which are usually included in basic courses on linear algebra and algebra in the first two years of study. In addition, it also includes a lot of non-standard and interesting material going into several different directions. The book is based on the long time teaching experience of the author. At the beginning, main algebraic structures are introduced (groups, rings, fields, algebras, vector spaces). Polynomial algebra is studied in detail and basic facts of group theory are covered. Linear algebra is covered in Chapter 2, Chapter 5 and Chapter 6, together with bilinear and quadratic functionals. Chapter 8 contains a description of general multilinear algebra. The last four chapters are devoted to commutative algebra (principal ideal domains, Noetherian rings, algebraic extensions, and affine algebraic varieties), groups (Sylow theorems, simple groups Galois extensions and Galois theory), linear representations of associative algebras (complete reducibility, invariants, division algebras) and linear Lie groups (the exponential map, the adjoint representation, basic facts on linear representations). The book is beautifully written, the choice of topics and their order is excellent and the book is very carefully produced. It contains a huge number of exercises and it appeals to geometric intuition whenever possible. It can be highly recommended for independent reading or as material for preparation of courses. (vs)

C. Voisin: ***Hodge Theory and Complex Algebraic Geometry I,*** *Cambridge Studies in Advanced Mathematics 76, Cambridge University Press, Cambridge, 2002, 322 pp., £55, ISBN 0-521-80260-1*

As the title clearly implies, the book deals with the basics of Hodge theory and its relation with complex algebraic geometry. The first four chapters are devoted to preliminaries. The main result of the first chapter is the Riemann and Hartogs Theorems on extension of holomorphic functions and existence of local solutions to the Cauchy-Riemann equations. The second chapter contains an introduction to (holomorphic) vector bundles and the Dolbeault complex on differentiable manifolds with complex structure (determined from an almost complex structure via Newlander-Nirenberg theorem). The third chapter contains a self-contained introduction to Kähler geometry, Kähler metrics and Chern connections on a holomorphic vector bundle equipped with a Kähler metric. The introductory part ends with the fourth chapter describing theory of sheaves, cohomology of a topological space with values in a sheaf and theory of acyclic resolutions leading to a proof of the de Rham theorem.

The second part of the exposition is devoted to a proof of the Hodge and Lefschetz decomposition theorems of cohomology of a complex manifold. The first two chapters of this part summarize a necessary background from analysis on Hilbert spaces used to define (formal) adjoints of elliptic operators, their Laplace operators and finally, as an application, harmonic forms and their relation to cohomology. The following two chapters give conceptual applications of these results. The notion of a polarized Hodge structure is explained and applied to the Kodaira embedding theorem, which states that a complex manifold is projective if it admits an integral polarization. The next chapter is devoted to the holomorphic de Rham complex and the interpretation of the Hodge Theorem in terms of degeneracy of the Frölicher spectral sequence. The chapter ends with an introduction to holomorphic de Rham complex with logarithmic singularities for quasi-projective smooth varieties with mixed Hodge structure on their cohomology. The third part is devoted to a study of variations of Hodge structures. The notion of a family of complex differentiable manifolds leads to the construction of the Kodaira-Spencer map and Gauss-Manin connection associated to the local system of cohomology of fibers of this family. Using the Kodaira-Spencer map and the cup product in Dolbeault cohomology, the period map and its differential are described. In the last chapter, various "cycle classes" are studied. In particular, Hodge classes arising in the study of morphisms of Hodge structures are described in more detail. The Deligne cohomology and the Abel-Jacobi map are introduced, although they are studied in more detail in the next volume of the series. (pso)

C. Voisin: ***Hodge Theory and Complex Algebraic Geometry II,*** *Cambridge Studies in Advanced Mathematics 77, Cambridge University Press, Cambridge, 2003, 351 pp., £60, ISBN 0-521-80283-0*

The book is the second volume of a two-volume treatise on Hodge theory and its applications. The volume consists of three parts. The first part illustrates various aspects of the qualitative influence of Hodge theory on the topology of algebraic varieties. In particular, the Deligne's theorem on the degeneration of Leray spectral sequence of rational cohomology of a projective fibration at E_2 and its consequences, e.g. surjectivity of the map from rational cohomology of the total space to (the base generated) monodromy invariant subspace of rational cohomology of the fiber, are discussed.

The second part is devoted to the study of infinitesimal variations of Hodge structure for a family of smooth projective varieties and its applications, in particular those concerning the case of complete families of hypersurfaces of complete intersections of a given variety. The main explicit result in this part is Nori's connectivity theorem.

The third (and final) part of the volume is devoted to relations between Hodge theory and algebraic cycles. Using infinitesimal techniques from the second part, certain cycle class maps and equivalence relations (rational, homological, algebraic and Abel-Jacobi equivalence) are established. In particular, variations on the theme of the relation of Chow groups and Hodge theory of smooth complex varieties are reviewed. (pso)

V. A. Zorich: ***Mathematical analysis I,*** *Universitext, Springer, Berlin, 2004, 574 p., €53,45, ISBN 3-540-40386-8*

V. A. Zorich: ***Mathematical analysis II,*** *Universitext, Springer, Berlin, 2004, 681 p., €53,45 , ISBN 3-540-40633-6*

This is a very nice textbook on mathematical analysis, which will be useful to both the students and the lecturers. The list of chapters is as follows: Vol. I. 1) Some General Mathematical Concepts and Notation, 2) The Real Numbers, 3) Limits, 4) Continuous Functions, 5) Differential Calculus, 6) Integration, 7) Functions of Several Variables, 8) Differential Calculus in Several Variables, Some problems from the Midterm Examinations and Examination Topics. Vol. II. 9) Continuous Mappings (General Theory), 10) Differential Calculus from a General Viewpoint, 11) Multiple integrals, 12) Surfaces and Differential forms in R_n, 13) Line and Surface Integrals, 14) Elements of Vector Analysis and Field Theory, 15) Integration of Differential Forms on Manifolds, 16) Uniform Convergence and Basic Operations of Analysis, 17) Integrals Depending on the Parameter, 18) Fourier Series and Fourier Transform, 19) Asymptotic Expansions, Topics and Questions for Midterm Examinations and Examination Topics.

About style of explanation one can say that the definitions are motivated and precisely formulated. The proofs of theorems are in appropriate generality, presented in detail and without logical gaps. This is illustrated in many examples (many of them arise in applications) and each section ends with a list of problems and exercises, which extend and supplement the basic text. Finally, one can make several remarks on the approaches used. Real numbers are introduced axiomatically, the general concept of limits with respect to (filter) base is explained and used, e.g. in the definition of Riemann integral, and real powers of a positive number are introduced as limits of rational powers. Trigonometric functions are firstly introduced intuitively using the unit circle, then as sums of some power series and finally as inverse functions to functions arcsine and arccosine, which are defined after definition of the length of a curve. The multiple integral is firstly introduced as a Riemann integral over an n-dimensional interval (analogous to the 1-dimensional case). Then for the bounded set, D is defined as the integral over an interval containing D of the product of the given function and the characteristic function of the set D. The Lebesgue necessary and sufficient criterion for integrability is proved and frequently used. Line and surface integrals are introduced as integrals of differential forms over surfaces. Smooth and piecewise smooth surfaces are considered. Fundamental integral formulas (including the general Stokes formula) are proved. This material is explained in more detail in Chapter 15. In Chapter 14, vector versions of fundamental integral formulas are stated and vector fields having a potential are also studied. (jkop)